

Proposed cardiac risk assessment system by hhrids - hospital and heart research institute and disease studies for cardiac and non cardiac surgery

Abstract

Pre and post operative risk and mortality assessment is an utmost for any surgery. So an improved risk assessment system can save life from over enthusiastic surgery and can modify some variable risk factors which ultimately scores down the expected risk and most of the time can warn surgeon about pre and post operative complications and helps to take necessary precautions pre operatively and most importantly patient can get the information of relative risk in the proposed operation and can think twice before giving consent. Taking all these factors under consideration HHRIDS has proposed a risk assessment system (CRASH).^{1,2} Including 20 factors which are easily obtainable most of which are obtained from simple history taking physical examination and doing some very simple investigations. Among them 3 factors are non modifiable and 17 others are well modifiable where just taking some simple measures those can be modified and total risk is down scored. Lowest score is 0 and highest possible score is 80. Where it is assumed that risk score of 80 has 100% chance of pre and post operative complications including chance of mortality so for each score post operative complication is assumed as 1.25%. Estimated scores of included cases who are having some sort of pre and post operative complications including 30 days mortality are distributed and divided in 3 groups (<10% lying below 1st decile, 10-40% lying between 1st - 4th decile and > 41-100% range of data lying above 4th decile) and patients are categorized as mild, moderate and high risk groups respectively. Here CRASH score < 8 (2-7), 8-32 and >32 (to be exact >32.8) are now being considered as low, moderate and high risk groups respectively. With total calculated score no of major scores (score 4) to be mentioned Eg. CRASH score 43 (with 4 majors).

Keywords: CRASH, HHRIDS, HHRIDS score, risk assessment system, cardiac risk assessment

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Introduction

Total 20 risk factors are selected for the risk scoring system. Among them 3 are non modifiable and 17 are modifiable where appropriate management of those risk factors can down regulate the risk score as well as can decrease the post operative complications and postoperative 30 days mortality. Vast retrospective and prospective study will go on for validation of the scoring system. But now it has been established on long time experiences and evidence based practice.

Methods

Here total score is calculated and expressed in decimal so all the values can be kept more clustered and in a short range so wide range of difference is avoided (eg. if the score is 60 then its expressed as 6 and estimated per and post operative complication is $(1.25 \times 60) = 75\%$ and categorized as high risk group 20 risk factors were identified and they were sub classified and scored arbitrarily from zero (for normal values) to highest score of 4 and the top scored factors are considered as offending agents and sub classes are stratified and standardized equivalently.^{3,4} Currently it's being practiced in HHRIDS and simultaneously both retrospective and prospective studies are going on to validate the scoring system. Inclusion criteria for both cohort study and case control study is all patients undergoing cardiac and non cardiac surgery but patients having per operative events responsible for post operative complications even death after 30 days of operation are excluded and followed up to 30 days post operatively in cohort study and in case control study patients having complications due to per operative events are excluded.^{5,6}

Trials for Validation of the risk scoring system

Both cohort and case control study will be conducted under HHRIDS, over a period of 3-5 years. Separate Complete data will be collected from (N) no of patients and will be analyzed. Forward univariate logistic regression will be used to select the independent predictor variables of pre and post operative complications including postoperative 30 days mortality, and then multivariate logistic regression will be applied to the data to construct and validate the scoring system. Inclusion criteria for both cohort and case control study is all patients undergoing cardiac and non cardiac surgery but patients having per operative events responsible for post operative complications even death within 30 days of operation are excluded and followed up to 30 days of operation in cohort study and in case control study patients having complications due to per operative events are excluded.

First of all Estimated scores of included cases who are having some sort of pre and post operative complications including post operative 30 days mortality are distributed in decile form and divided in 3 groups (<10% lying below 1st decile, 10 - 40% lying between 1st - 4th decile and > 41-80% range of data lying above 4th decile) and patients are categorized as mild, moderate and high risk groups respectively) formula for Nth decile $N(n+1)/10$

Results

20 variables found to be independent predictors of pre and post operative complication including 30 days mortality. These variables are subsequently incorporated into the proposed risk scoring system

(CRASH). The number per and post operative complications including 30 days mortality observed and the number predicted by the scoring system, indicated good concordance (χ^2 test, P=..). The area (se) under the receiver operating characteristic curve was which demonstrated a reasonable predictive value for the score. Validation of scoring system
 Sensitivity (SEN) = $\frac{a}{a+c} \times 100$ (proportion of disease positive who are test positive/increase SEN less FN so 100% SEN means all disease positives are true positive no FN/highly sensitive test is helpful when test result is negative/important to rule out or exclude disease)
 Specificity (SPE) = $\frac{d}{b+d} \times 100$ (proportion of disease negative who are test negative/ increase SPE less FP so 100% SPE means all disease negatives are true negative, no FP/highly specific test is helpful when test result is positive/helpful to include/confirm disease)
 Positive predictive value (PPV) = $\frac{a}{(a+b)} \times 100$ (proportion of disease positive who are test positive/probability of having disease when person is test positive increase PPV decreases chance of false positive)
 Negative predictive value (NPV) = $\frac{d}{(c+d)} \times 100$ (proportion of test negative who are disease negative/probability of not having disease when person is test negative/increase NPV decreases chance of false negative)

$$\text{Positive likelihood ratio (LR+)} = \frac{\left[\frac{a}{(a+c)} \right]}{\left[\frac{b}{(b+d)} \right]} = \frac{SEN}{(1-SPE)}$$

(probability of positive test result when the person is diseased LR+=no diagnostic value, >1=diagnostic value, >10=high diagnostic value)

$$\text{Negative likelihood ratio (LR-)} = \frac{\left[\frac{c}{(a+c)} \right]}{\left[\frac{d}{(b+d)} \right]} = \frac{(1-SEN)}{SPE}$$

(probability of negative test result when the person is not diseased LR-0=no diagnostic value, <1=diagnostic value, <.1=high diagnostic value) comparison with other systems will be calculated by χ^2 test for each risk groups (low moderate and high risk group) (Table 1-3).

Table 1 Proposed cardiac risk assessment system by HHRIDS (CRASH)

No.	Risk factors	score
1.	AGE	
	<40years	0
	40-49years	1
	50-59years	2
	60-69years	3
	>70years	4
2.	previous operation	
	No operation	0
	Uneventful operation	1
	Cardio respiratory operation	4
3.	Pre operative conditions	
	Healthy/fit	0
	ASA1	
	ASA2	
	ASA3	
	ASA4	
	ASA5/surgical site infection/moribund/septicaemia/SIRS	4
4.	GCS	
	15	0
	12+	1
	7-12	2
	4-6	3
	<3	4

Discussion

There are 17 factors which can be modified and thus risk can be down scored.

Age

It's not modifiable and risk increases with age as BP increases after 50years.³ Pre operative anemia correction when Hb% <8gm/dl.⁴

Smoking

According to the American Cancer Society, within just 20minutes of your last cigarette, your blood pressure and pulse rate drop to normal levels. Within 48 hours, your ability to smell and taste are enhanced. After 2 to 12weeks, circulation improves and lung function increases by up to 30%. Breathing be-comes noticeably easier. Within a year, the risk of heart disease drops to half that of a current smoker. At the 5-year mark, the death rate from lung cancer for the average former pack-a-day smoker decreases by almost 50%. By 10years, the death rate from lung cancer is similar to that of nonsmokers. At 15years, the risk of heart disease is the same as that of a nonsmoker." Patient having pre operative renal impairment has a chance of developing post operative anuria, renal shut down so pre operative management of renal function and at the same time correction of electrolytes are very obvious issue particularly potassium and sodium.^{7,8} Inspection of incision site is so important as those things are often missed in clinical practice so we have put that as a risk factor as it leads to post operative wound infection, delayed wound healing even septicemia or SIRS. Pre operative respiratory function is too worthy as it may lead to post operative atelectasis, hypoxia even respiratory failure, pre operative use of bronchodilator even till the morning of operating day may decrease post operative complication.³ Pre operative hypertension reduction is a burning issue in any types of surgery few simple measures and monitoring and prompt action may reduce post operative complications and antihypertensive is recommended even in the morning of operating day. DM is also a risk factor that must be taken care of, if possible surgery can be postponed till diabetes is well controlled and OT should be performed with sliding scale coverage and insulin should be continued till patient is switched to oral diet.

Table Continued...

No.	Risk factors	score
5	Temparature	
	36-38.4	0
	(30-40.9) (30-39)	2
	≥41 ≤29°C	4
6.	History of previous MI	
	No history	0
	>6months	1
	3-6 months	
	<3 months	
7.	Stress activity index	
	No angina/no limitation of activity	0
	no limitation of activity except in fast run (>6MET),exercise(>4MET) Dukes grade I	1
	Slight limitation of activity cant climb >2stair can't walk>2 block at level Angina Walking up hill after meal/ cold weather Dukes grade II	2
	Marked limitation of activity Cant climb>1 stair,cant walk>1 block at level,limitation in walking eating clothing(3-4METS)-Dukes grade III	3
	Rest angina-Dukes grade IV	4
8.	pulse	
	80-120	0
	<40 >120 regular	3
	<40 >120 irregular, drop beat	4
9.	BP	
	<120,<80 optimal	
	<130,<85 normal	0
	(140-159),(90-99)grade I	1
	(160-179),(100-109)grade II	2
	>180,>110 grade III	3
	Malignant HTN, grade IV, target organ damage, refractory to Rx	4
10.	DM	
	No DM	0
	CAT-A(F<10,R<14,HbA1c<8%)	1
	CAT-B(F<14,R<14-17,HbA1c<8-10%)	2
	CAT-C(F>1410,R>17,HbA1c>10%)	3
	Type I,GDM,pregnancy,undergoing surgery,uncontrolled,DKA	4
11.	Respiratory rate/function	
	No dyspnoea in normal pace	0
	14-20 /dyspnoea/can walk as long as like with taking time	1
	20-30/orthopnoea/block limitation	2
	30-40/PND/dyspnoea on ordinary exercise(room to bath/kitchen)	3
	>40 or<5/rest dyspnoea	4
12.	Obesity(more than double weight than expected at that age and height of individual	
	BMI20-25	0
	BMI 25-30(pre obase)	1
	BMI 30-35(mild obase /class I)	2
	BMI 35-40(moderate obase/class II)	3
	BMI>40 morbid obase(class III)	4
13.	LVEF	
	Normal (still there is 12% risk)	1
	>55(2.2% risk)	2
	35-54(5.4% risk)	3
	<35(19.5%risk)	4
	(<50 >70) in cardiac surgery	4
14.	Chol : HDL	
	<7	0
	>7	4
15.	Renal impairment	
	Urine output >30ml/hr	1
	Urine output 20-30mi/hr	2
	Urine output 5-15ml/hr	3
	Urine output <5ml/hr, serum creatinine>1.2mg/dl	4
16.	Serum potassium	
	3.3-5.5	0
	<2.9 >5.9/7mmol/lit	4
17.	Haemoglobin	
	>10gm/dl	0
	<8gm/dl	1
	6-8gm/dl	3
	<6gm/dl	4

Table Continued...

No.	Risk factors	score
18.	ECG	
	normal	0
	ST-T change	4
	Pathological Q	4
	Ectopics >4/min	4
	Abnormal QRS	4
19.	Proposed operation	
	Minor elective single procedure	1
	Major single procedure elective	2
	Major more >1 procedure elective	3
	emergency	4
20.	Smoking	
	Non smoker	0
	Ceased 10years back	1
	Ceased up 5years back	2
	Ceased up <3months back	3
	Current smoker	4

Table 2 Testing of scoring system

Test(scoring system)	Gold standard (clinically observed)		Total
CRASH positive	a(TP)	b(FP)	a+b
CRASH negative	c(FN)	d(TN)	c+d
total	a+c	b+d	N=a+b+c+d

Table 3 Comparison with other systems by χ^2 test for each risk groups(low moderate and high risk group)

Test	Outcome +ve (with complication)	Outcome -ve (No complication)	Total
New(Crash)	a	b	a +b
Old/conventional	c	d	c+d
total	a+c	b+d	GT=a+b+c+d

Conclusion

We have developed and validating a scoring system that reliably will predict the probability per and post operative complications including 30days mortality.

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Conflicts of interest

Author declares there are no Conflicts of interest.

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